Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/138
UNITED KINGDOM
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

GAS CIRCULATORS AND THEIR DRIVES FOR LARGE GAS-COOLED POWER REACTORS

H. Bateman
G.L. Duffett
W. Johnson
United Power Company Limited, London

The two basic types of circulators and the many forms of drive available are investigated and discussed together with examples of their application and the reasons for the choice.

Centrifugal and axial circulators main features are described together with an extensive discussion on the relative merits of steam turbine drive, fixed speed a.c. electric, variable speed a.c. electric and variable speed d.c. motor drive.

Electric motor drive has the advantage of simplicity but constant speed a.c. motors demand either a gearbox or that the circulator speed be matched to a 2 or 4 pole motor which may compromise circulator design. Variable speed a.c. motors require either a variable frequency supply at high initial plant cost or brush gear of high current carrying capacity with attendant maintenance needs whilst d.c. motors have a limited capacity and require expensive rectification or conversion equipment.

Steam turbine drive proves attractive if the optimum level of h.p. steam generation matches the blower power when the exhaust pressure is made to coincide with the pressure of l.p. system in a dual pressure cycle. Reheating of the partly expanded h.p. steam and mixing with l.p. steam provides a neat and economic method of controlling the moisture content of the steam in the l.p. cylinders of the main turbine.

The necessity for trouble free gas seals to prevent the escape of toxic gas from the reactor pressure circuit is stressed.

A section of the paper is devoted to the more important aspects of circulator control and the influence of safety consideration upon control philosophy. The self cooling feature of steam turbine driven circulator is outlined and the incorporation and use of pony motors is discussed.

Commissioning tests prior to criticality to prove mechanical soundness of the circulator machinery and freedom from vibration of pressure circuits have an influence upon the type of drive and the purpose of various tests performed at site is described.

A review is included of the circulator and drive features of civil power reactors designed in the U.K. which demonstrates that development and design philosophy has naturally fallen into 3 broad stages.

The first stage involved electric motor drive and the principle of coolant gas flow control by means of speed variation whilst the second stage had variable speed steam turbines or fixed speed electric motors with valve control of the gas flow.

Monolithic concrete pressure vessels containing the reactor core, boilers and circulators currently being constructed constitute the third stage and pose new problems. The diameter and number of vessel penetrations must be minimal. Gas flow control by valving is difficult to achieve for regulating devices would have to be within the vessel with the circulators. Flow control by speed variation has again become attractive. The paper is concluded with a brief discussion on future trends.